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ABSTRACT

Person fit in the Rasch one parameter model is investigated. The first set of data deals with grade 3 students responding to the mathematics computation and reading vocabulary subscales of the Comprehensive Test of Basic Skills Forms (CTBS/S). The second set of data deals with grade 3 students responding to the Basic Skills Assessment Program pilot testing on reading and mathematics statewide objectives. The only three variables available for study with these samples were ability, sex, and race. Four tables are given to relate the CTBS/S scores with the South Carolina Basic Skills Assessment Program scores. Such things as the proportion of male/female misfitting subjects and proportion of male/female total sample and these proportions divided among blacks and whites are given. Reasons for misfits analysis and cautions about interpreting such tables are also outlined. (CE)

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Person-Fit to the Rasch Model Using Norm-Referenced and Criterion-Referenced Statewide Data

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Introduction

This study investigates person fit in the Rasch one parameter model. Two different types of test data are examined. The first set of data deals with students in Grade 3 responding to the Mathematics Computation and Reading Vocabulary subscales of the Comprehensive Test of Basic Skills Form S (CTBS/S) Level 1. The second set of data deals with students in Grade 3 responding to the Basic Skills Assessment Program pilot testing on the Reading and Mathematics Statewide Objectives.

The CTBS/S is administered as part of the South Carolina Statewide Testing Program. Approximately 25,000 third-grade students took the on-level, CTBS/S Level 1 examination. From the state files of students taking Level 1, a systematic random sample of 1500 subjects was drawn. Students' performance on the Reading Vocabulary and Mathematics Computation subtest were examined. The Vocabulary subtest consisted of 40 items while the Mathematics subtest contained 48 items.

The criterion referenced test under investigation was part of the South Carolina Basic Skills Assessment Program. Inherent to this program was the selection or development of criterion-referenced tests that would assess student achievement in reading and mathematics in grades one, two and three. Once the test was developed the pilot testing of the instrument was conducted to determine the validity of the test items. Approximately 1100 students were randomly selected in such a manner that all achievement levels as well as ethnic groups were represented. The test form under investigation consisted of 36 reading items and 30 mathematic items. This form was developed in a manner that each statewide reading and mathematics objective was represented by six items on the test.

Results

The results of the Rasch analyses of the CTBS/S and BSAP data are summarized in Table I. The total number of subjects in each sample is reported; as is the number of subjects who did not make perfect scores or scores of zero. This latter group are the only subjects available for analysis, since abilities for subjects with perfect scores or zero scores cannot be estimated. The mean raw score is reported next for general descriptive purposes.

The smallest number of misfitting items was 7 which occurred on the BSAP mathematics test. Fifty percent of the CTBS/S Vocabulary items misfit while less than 35% of the BSAP reading items misfit.

The largest number of subjects which had responses that differed significantly from the responses predicted by the model occured in the 40-item CTBS/S vocabulary subtest. The 52 misfitting subjects represented 3.47% of the available subjects. These same students were examined using the CTBS/S mathematics subtest. However, only 24 or 1.6% misfit was found in the 48-item CTBS/S math subtest. For the BSAP test items, a reverse situation appears to be present. That is, the largest proportion of misfitting subjects were found in the smaller 30 item math test (2.38%) while the 36-item reading test exhibited 1.85% subject misfit.

Discussion on Misfit

Three characteristics of the subjects were examined in order to determine whether the misfitting subjects shared some common trait. The only three variables available for study with these samples were ability, sex and race.

The last two columns of Table I report the mean estimated ability on each test with all subjects included and with misfitting subjects deleted from the sample. Since the mean ability increases after the misfitting subjects are deleted the majority of the subjects who misfit the model must have lower than average abilities.

Of the 1500 subjects responding to the CTBS/S Mathematics Computation and Reading Vocabulary subtests 51.5% were females and 48.5% were males. When the 24 misfitting subjects in Mathematics Computation were considered 62.5% were male and 37.5% were female. However, in Reading Vocabulary, of the 52 misfitting subjects 48% were male while 52% were female. Even though a larger proportion of males was found among the misfitting subjects of the Mathematics Computation subtest than in the overall sample, a Chi-square test for the differences in proportions did not reach significance (See Table II). The Chi-square obtained for the math subtest was 1.14 while the one obtained for the Reading Vocabulary subtest was .24. Neither was significant ($p < .05$).

Of the 1500 individuals whose race code was identifiable, 63.3% were white while 36.7% were black. A somewhat different proportion was found in the misfitting group for the Vocabulary subtest. For the Vocabulary subtest, 65% of the misfitting subjects were black and 34.6% were white. The Chi-square for these proportions was highly significant ($p < .001$). However, in the Math subtest of CTBS/S, the proportion of misfitting subjects who were black was almost identical to the entire sample proportion and thus yielded a non-significant Chi-square. (See Table III)

For the two BSAP exams under investigation the male/female proportion of misfitting students did not differ significantly from that of the total sample (See Table IV). The black/white proportion of misfitting students was almost significantly different from that of the total sample in the Reading part of the test (See Table V). However, the proportion for the Mathematics part resembled that of the total sample.

Caution should be exercised in the interpretation of the above results. The data under investigation indicate that the misfitting subjects tended to have lower than average abilities. A careful examination of the subjects misfitting in each group confirms this observation. For most cases, person misfit occurred when low ability students correctly responded to relatively difficult items. According to the model such events occur with very low probability and hence certain low ability subjects were identified as misfitting.

The unexpected correct responses of the low ability subjects might have several explanations. The subjects may be in classrooms with particular curricula emphasis. The misfitting students may have acquired knowledge outside the classroom which helped in answering some difficult items. A very plausible explanation is that some low ability subjects were guessing selectively when they attempted very difficult items.

The misfit analysis also reveals that the proportion of blacks who misfit was slightly larger than the proportion of blacks found in the total sample. While black students constituted about 36% in one sample and 45% in the other, more than half the misfitting subjects were black in 3 of 4 cases studied. This misfit could lead to the hasty inference that the tests were particularly inappropriate for blacks. Such an inference is confounded, however, by the fact that blacks in the samples tended to score

lower than whites. Thus the larger proportion of misfit among blacks may simply be a manifestation of the previously discussed issue of extensive misfit among low ability subjects.

In summary, the analysis of both the CTBS/S data and the BSAP field-test data indicate a very small proportion of misfitting subjects. Out of 1500 subjects who took the CTBS/S only 52 instances of subject misfit were encountered. This represented less than 4% of the total number of responding students. The BSAP field test found a lesser proportion of misfit, with 2.4% of the students misfitting in the mathematics portion of the test. The analysis offers some speculation about the causes of misfit. The most plausible explanation is that misfit was due to unexpected correct responses provided by low ability students on difficult items. The analyses further shows that blacks more often than whites tend to misfit the model. However, these characteristics of the misfitting student are related to the fact that the low achieving students tend to be black.

TABLE 1

CTBS/S and BSAP Data Analyses Summary

Grade 3, Spring, 1980

Test Name	No. of Subjects: Total	No. of Subjects: Non-zero + Non-perfect	Number of items	Mean Raw Score	Misfit Information: #Items Misfit	Misfit Information: #S's Misfit	Mean Ability: All S's	Mean Ability: Deleting Misfit S's
CTBS/S Level 1 Math	1500	1450	48	35.1	22	24 (1.6%)	1.47	1.51
CTBS/S Level 1 Voc	1500	1483	40	23.7	20	52 (3.5%)	0.60	0.67
BSAP Math	1133	1078	30	19.6	7	27 (2.4%)	1.22	1.31
BSAP Reading	1133	1050	36	24.8	11	21 (1.8%)	1.27	1.31

Table II

Proportion of Male/Female Misfitting Subjects
and Proportion of Male/Female of Total Sample

A. Mathematics Computation (CTBS/S)

		Group	
	Number Column %	Misfitting S's	Individual S's
Sex	Male	15 62.5%	771 48.5%
	Female	9 37.5%	726 51.5%
		24	1479

Chi-Square = 1.14

B. Reading Vocabulary (CTBS/S)

		Group	
	Number Column %	Misfitting S's	Individual S's
Sex	Male	25 48.1%	771 48.5%
	Female	27 51.9%	726 51.5%
		52	1479

Chi-Square = .24

Table III

Proportion of Black/White Misifitting Students
and Proportion of Black/White of Total Sample

A. Mathematics Computation (CTBS/S)

		Group	
	Number Column %	Misfitting S's	Individual S's
Race	Black	9 37.5%	541 36.7%
	White	15 62.5%	934 63.3%
		24	1475

Chi-Square = .007

B. Reading Vocabulary (CTBS/S)

		Group	
	Number Column %	Misfitting S's	Individual S's
Race	Black	34 65.4%	541 36.7%
	White	18 34.6%	934 63.3%
		52	1475

Chi-Square = 17.6 $p < .001$

Table IV

Proportion of Male/Female Misfitting Subjects
and Proportion of Male/Female of Total Sample

A. Mathematics (BSAP field test)

	Group		
	Number Column %	Misfitting S's	Individual S's
Sex	Male	13 48%	560 49.6%
	Female	14 52%	568 50.4%
		27	1128

Chi-square = .024

B. Reading (BSAP field test)

	Group		
	Number Column %	Misfitting S's	Individual S's
Sex	Male	11 52.4%	560 49.6%
	Female	10 47.6%	568 50.4%
		21	1128

Chi-square = .062

Table V

Proportion of Black/White Misfitting Subjects and Proportion of Black/White of Total Sample

A. Mathematics (BSA) field test)

	Group		
	Number Column %	Misfitting S's	Individual S's
Race	Black	14 52%	509 45.12%
	White	13 48%	619 54.88%
		27	1128

Chi-square = .48

B. Reading (BSAP field test)

	Group		
	Number Column %	Misfitting S's	Individual S's
Race	Black	13 62%	509 45.12%
	White	8 38%	619 54.88%
		21	1128

Chi-square = 2.34